# NEOGENE STRATIGRAPHIC DEVELOPMENT OF THE PERSIAN GULF

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## LONG TERM GOALS

The Persian Gulf is a shallow (<110 m), epicontinental basin formed on the Arabian plate in mid-late Miocene. Neogene sediments comprise a northwest-thickening wedge (0.1-2.0 km) of clastics shed from the Zagros uplift. There is little publicly available information on these deposits. Our long-term goal is to understand how variations in source, tectonic subsidence, climate, and sea level affected sedimentary process and stratigraphic development of an arid, shallow-marine environment.

## OBJECTIVES

The initial objective of this project was to define the broad lateral and temporal patterns in late Cenozoic stratigraphy in the central portion of the basin. Our objectives also include mapping late Quaternary channels, deltas, and sequence stratigraphy across the entire basin and correlating these to wells and surface sediment cores. These data will be used to test our hypothesis that wet-dry cycles in climate are as important to channel and sediment sequence development as sealevel change. We will also determine the age and origin of linear seafloor microtopography at the head of the Gulf and in the Straits of Hormuz.

## APPROACH

The initial objective was addressed with award N00014-96-1-0548 and consisted of a study of existing industry data. Richard Simmons at Navoceano (N5) provided funds (as an expansion to this grant) for purchase from Masera Corp. of logs for 25 Iranian wells in the Gulf and paper copies of ~5,000 km of multi-fold industry seismic profiles. Based on area covered, 50-60% of the seismic profiles are of such low quality in the Cenozoic section (upper 0.5-0.9 sec) that it is difficult to recognize reflectors much less unconformities. In addition to the Masera data, we used seismic profiles from an *Atlantis II* cruise in 1977 and published formation tops for 17 additional wells in the Gulf and Iran and 12 wells in Iraq. At WHOI, Tom Bolmer digitized cdp points and well locations, and Elazar Uchupi provided background for interpretation of results.

The remaining objectives will be addressed under separate funding (N00014-97-0410). We plan a seismic and seafloor mapping cruise in the Gulf using a multi-channel, high-resolution, shallow-water seismic system provided by LDEO (J. Diebold and P. Buhl). We will sail on a Navoceano ship (USN Kane) and use their coring, side-scan, and high-frequency profiler. Sonobuoy data will be recorded to determine shallow sediment velocities (J. Diebold LDEO). E. Uchupi (WHOI) will help interpret seismics, direct age dating of cores, and assist in final reports. P. Demenocal (LDEO) will analyze core material to infer climatic cycles. Ashok Kalra (N5) is our point-of-contact at Navoceano. Use of the Navoceano ship is being coordinated through M. Jarrett and P. Taylor (N3). Dave Powell (N3) provided constraints on cruise tracks.

## WORK COMPLETED

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CDP points for the industry profiles were digitized and plotted. Tables of sonic log velocity, calibrated with check-shot profiles, were typed into computer files and plotted. Both interval and "average" velocities are available. The well reports contain formation tops for only two wells. Cenozoic time datums can be picked from logs in 7 other wells. We identified several Neogene seismic events, but the only feature that can be traced across the central basin is the unconformity at the K/T boundary. Poor quality data in the upper 0.5 sec prevents extensive mapping of any of the younger unconformities. Unit thickness was computed using sonic log velocities calibrated with check-shot profiles.

Planning for our seismics cruise began with a meeting at Navoceano in March. The cruise was scheduled for August '97 and equipment preparation was completed at WHOI and LDEO. In April, just prior to shipping, the Navy reprioritized Kane's schedule, and the cruise was postponed to October. In late June, the Navy again changed Kane's schedule. We expect the cruise to be scheduled in 1998.

**RESULTS**

The primary feature of the K/T surface is a deepening from ~0.4 to 2 km towards Iran. Secondary features include uplift due to arches in the Paleozoic basement, Quaternary folding near the Iranian coast, and salt movement. The lower Miocene datum mapped with wells also dips to the northeast in the central Persian Gulf. The northwest-southeast strike changes, however, in the north end of the Gulf where the surface shallows from ~1.8 km near Karg Island to <500 m in southeast Iraq.

The sonic logs, calibrated to seismic frequencies with check shot profiles, indicate vertical velocities at the seafloor are 1.6-1.8 km/s. Below the seafloor, velocity varies vertically by up to 1.5 km/s over 10-20 m, however the fluctuations average over 100-200 m to a simple linear increase in velocity down to the base of the Paleocene. As the Neogene clastic wedge thins southwestward from Iran, the magnitude of the gradient increases and the thickness decreases from 1.5 to 0.8 km below sealevel.

**IMPACT/APPLICATIONS**

The deepening of the Miocene and K/T horizons towards the northeast reflects tectonic subsidence driven by either flexing of the plate by forces along its edge or the shifting sedimentary load on the plate due to the southwestward sliding of the Zargos Fold Belt along a deep salt layer. The shallowing of Cenozoic datums across the northern end of the Persian Gulf indicates that tectonic subsidence in the Mesopotamian valley of Iraq is slower than subsidence in the Persian Gulf. We infer that the present partition of the depression into water and land areas is due to differences in subsidence rate and not to higher supply rates of sediment in Iraq.

**TRANSITIONS**

The Geospatial Data Base Department at Navoceano will use the Masera well velocities in future revisions to their Persian Gulf layered velocity model data base. One of the primary objectives of the 1998 cruise will be to obtain interval velocities from multi-channel semblance data and refraction velocities from the sonobuoys. These data will provide direct, systematic measurements of seafloor velocity data base for Navy operations in the Persian Gulf.

**RELATED PRODUCTS**

The high-resolution seismic and seafloor mapping study will provide an arid environment end-member to the STARTIFORM field studies.
Amy Bower (WHOI PO) has studied Persian Gulf bottom water outflow using Navoceano AXBTs. We hope to obtain water temperature data for her on our transits through the Straits of Hormuz.

**REFERENCES**

We used the Masera well data in the following report in preparation:
Uchupi, E., S.A.Swift, D.A. Ross, Late Quaternary paleoceanography, paleoclimatology, and neotectonism of the Persian Gulf.